

IN THE SPECIFICATION:

Please replace paragraph [0005] with the following amended paragraph:

[0005] From DE 39 12 944 A1, there is known a belt tensioning device wherein the spring element is provided in the form of a rotary bar spring which is composed of a plurality of rotary bars and whose longitudinal axis extends parallel to the axis of rotation of the tensioning roller. The tensioning roller is supported in a tensioning lever which is arranged at the free end of the rotary bar spring. The fixed end of the rotary bar spring is firmly clamped into holding means provided with bolting means for being fixed to a fixed housing. In order to prevent the rotary bar spring from bending under load, it is arranged in a guiding tube, with the rotary bar spring and the guiding tube, at the end carrying the tensioning lever, both being connected in a rotationally fast fixed way to the tensioning lever. The guiding tube, in turn, is rotatably supported in the engine block.

Please replace paragraph [0008] with the following amended paragraph:

[0008] A first solution is provided by a belt tensioning device for a belt drive having at least two belt pulleys and a continuous belt. The device includes a torsion spring assembly with a longitudinal axis A_2 and with at least one torsion bar or torsion tube. The torsion spring assembly can be clamped axially and in a rotationally fast fixed way into a rack. The tensioning device further includes a tensioning arm which, by way of its one end, is arranged at the torsion spring assembly so as to be aligned approximately radially relative to the longitudinal axis A_2 , as well as a tensioning roller which is rotatably fixed at the other end of the tensioning arm. The axis of rotation A_1 of the tensioning roller extends substantially parallel relative to the longitudinal axis A_2 of the torsion spring assembly. The tensioning arm can be resiliently supported relative to the rack so as to oscillate around the longitudinal axis A_2 . This first solution is suitable for applications which, in operation, have an unchanged driving pulley.

Please replace paragraph [0012] with the following amended paragraph:

[0012] The bundle of torsion bars can be clamped in at the first end of the torsion spring assembly in a first fixing bush, and it can be clamped in at the second end of the torsion spring assembly in a second bush which is connected in a rotationally fast fixed way to the supported end of the tensioning arm. The first fixing bush can be bolted in a rotationally fast fixed way to an engine housing for example or, if the outer circumference is out-of-round, it can be inserted in a positive and form-fitting way into a suitable recess in an engine housing.

Please replace paragraph [0013] with the following amended paragraph:

[0013] According to a further modification, the bundle of torsion bars can be enclosed by a tube which, depending on the method of fixing, can have a supplementary spring function or a supplementary damping function. According to a first variant, the tube, at its two ends, can be connected in a rotationally ~~fast~~ fixed way to the two ends of the bundle of torsion bars. More particularly, it can be connected in a rotationally ~~fast~~ fixed way to the first and second bushes and thus form a rotary tube spring connected functionally in parallel relative to the bundle of torsion bars.

Please replace paragraph [0014] with the following amended paragraph:

[0014] According to a second variant, the tube, at its one end, can be connected in a rotationally ~~fast~~ fixed way to the one end of the bundle of torsion bars and, at its other end, it can be freely rotatable by a limited angular amount relative to the other end of the bundle and, thereafter, can abut against the bundle. In such a case, the tube would become a rotary tube spring which is sequentially connectable to the bundle of torsion bars which, in consequence, increases an initially low spring rate of the torsion bars abutting against the bundle.

Please replace paragraph [0015] with the following amended paragraph:

[0015] According to a further variant, the tube, at its one end, can be connected in a rotationally ~~fast~~ fixed way to the one end of the bundle of torsion bars and, at its other end, it can be rotatable under friction relative to the other end of the bundle of torsion bars. In this case, the tube forms a friction damping element connected functionally in parallel to the bundle of torsion bars.

Please replace paragraph [0016] with the following amended paragraph:

[0016] According to a further variant, the tube, at its one end, can be connected in a rotationally ~~fast~~ fixed way to the one end of the bundle of torsion bars and, at its other end, it can be rotatable under friction relative to the other end of the bundle of torsion bars. In this case, the tube forms a friction damping element connected functionally in parallel to the bundle of torsion bars.

Please replace paragraph [0021] with the following amended paragraph:

[0021] According to a further variant, the tube, at its one end, can be connected in a rotationally ~~fast~~ fixed way to the one end of the bundle of torsion bars and, at its other end, it can be rotatable under friction relative to the other end of the bundle of torsion bars. In this case, the tube forms a friction damping element connected functionally in parallel to the bundle of torsion bars.

Please replace paragraph [0023] with the following amended paragraph:

[0023] In another aspect of the invention, the bundle of torsion bars is clamped in at the first end of the torsion spring assembly in a connecting bush and the bundle of torsion bars is clamped in at the second end of the torsion spring assembly in a bush which is connected in a rotationally ~~fast~~ fixed way to the first end of the one tensioning arm. There is thus formed a rotary tube spring functionally connected in series to the bundle of torsion bars. The bundle of torsion bars can also be enclosed by a tube which, at its one end, is connected in a rotationally ~~fast~~ fixed way to the connecting bush and, at its other end, it is connected in a rotationally ~~fast~~ fixed way to the second tensioning arm. There is formed an independent rotary tube spring in addition to the torsion bar spring.

Please replace paragraph [0025] with the following amended paragraph:

[0025] A first application of the second solution provides a belt drive having at least two belt pulleys and a continuous belt with a belt tensioning device of said type, wherein the torsion spring assembly is rotatably supported in a rack, wherein a first tensioning arm is connected in a rotationally ~~fast~~ fixed way to one end of a torsion spring unit and wherein the other tensioning arm is connected in a rotationally ~~fast~~ fixed way to the other end of the torsion spring unit.

Please replace paragraph [0026] with the following amended paragraph:

[0026] An alternative application provides a belt drive having at least two belt pulleys and a continuous belt with a belt tensioning device of said type. The torsion spring unit is clamped into a rack in a rotationally ~~fast~~ fixed way, and a first tensioning arm is connected in a rotationally ~~fast~~ fixed way to a first torsion spring unit, with the other tensioning arm being connected in a rotationally ~~fast~~ fixed way to a second torsion

spring unit. Assembly preferably takes place in such a way that the torsion spring unit is arranged outside the continuous belt, and the first tensioning arm, in its nominal position, extends parallel to the connection through the axes of rotation of two first belt pulleys, and the second tensioning arm, in its normal position, extends parallel to the connection through the axes of rotation of one of the two above-mentioned belt pulleys and a further belt pulley.

Please replace paragraph [0028] with the following amended paragraph:

[0028] A third solution provides a belt tensioning device for a belt drive having at least two belt pulleys and a continuous belt. The device includes a torsion spring assembly with a longitudinal axis A_2 and with at least one torsion bar. The torsion spring assembly can be clamped axially and in a rotationally ~~fast~~ fixed way into a rack. The belt tensioning device further includes a tensioning arm which, by way of its one end, is arranged at the torsion spring assembly so as to be aligned approximately radially relative to the longitudinal axis A_2 , as well as a tensioning roller which is rotatably fixed at the other end the tensioning arm. The axis of rotation A_1 of the tensioning roller extends substantially parallel relative to the longitudinal axis A_2 of the torsion spring assembly, and the tensioning arm is resiliently supported relative to the rack so as to oscillate around the longitudinal axis A_2 . The at least one torsion bar is enclosed by a tube in whose end arranged opposite the tensioning arm, there is secured in a rotationally ~~fast~~ fixed way the respective end of the at least one torsion bar and in whose other end the tensioning arm is supported in a radial bearing. The tensioning arm is connected in a rotationally ~~fast~~ fixed way to the other end of the at least one torsion bar and wherein the central plane of movement E of the tensioning roller is positioned in the central region of said radial bearing. There is thus provided a device which, in the bearing region between the rocker arm or tensioning arm carrying the tensioning roller and the tube which ensures that the assembly is fixed directly to a rack, i.e. more particularly to an engine block, is free from transverse forces and bending moments. It is thus possible to avoid the influence of bending in the bearing region of the tensioning arm, so that permanent functioning of the bearing is ensured, clean movements of the tensioning arms and tensioning rollers are guaranteed, and an increase in wear or friction in the bearing can be avoided. The central plane of movement is identical with the central roller plane which, in accordance with the invention, should be positioned in the central region of the axial length of the bearing, more particularly as centrally as possible relative to the axial length of said bearing.

Please replace paragraph [0031] with the following amended paragraph:

[0031] The bundle of torsion bars can also be clamped in at the second end of the torsion spring assembly into a second bush which is connected in a rotationally fast fixed way to the one end of the tensioning arm and which is rotatably supported relative to the tube. In this embodiment, too, the connection can be the form-fitting type between a through-aperture in the bush and the bundle of torsion bars.

Please replace paragraph [0033] with the following amended paragraph:

[0033] According to a fourth solution, the present invention provides a belt tensioning device for a belt drive having at least two belt pulleys and a continuous belt. The device includes a torsion spring assembly with a longitudinal axis A_2 , and with at least one torsion bar. The torsion spring assembly can be supported axially and radially in a rack. The belt tensioning device further includes two tensioning arms which, by way of their respective one ends, are arranged at the torsion spring assembly so as to be aligned approximately radially relative to the longitudinal axis A_2 , as well as two tensioning rollers which are rotatably fixed at the respective other ends of the tensioning arms. The axes of rotation A_1 , A_3 of the tensioning rollers extend substantially parallel relative to the longitudinal axis A_2 of the torsion spring assembly, and the tensioning arms are resiliently supported with respect to one another so as to oscillate around the longitudinal axis A_2 . The at least one torsion bar is enclosed by a tube in whose end opposed to the tensioning arms there is secured in a rotationally fast fixed way the respective end of the at least one torsion bar. On the other end of the tube, there is secured in a rotationally fast fixed way one of the tensioning arms and, the other one of the tensioning arms is supported in a radial bearing. The tensioning arm is connected in a rotationally fast fixed way to the other end of the at least one torsion bar, and the central plane of movement E of the tensioning rollers is positioned in the central region of the radial bearing.

Please replace paragraph [0035] with the following amended paragraph:

[0035] According to an embodiment of this solution, the torsion spring assembly comprises a plurality of individual torsion bars which, by being clamped together at their ends, form a bundle and are in line contact or surface contact with one another. The bundle of torsion bars can be clamped in at the first end of the torsion spring assembly in a first bush which is firmly connected to the tube and which, furthermore, can be clamped in at the second end of the torsion spring assembly in a second in a rotationally fast fixed way to the first end of the one tensioning arm and is rotatably supported relative to the tube.

Please replace paragraph [0037] with the following amended paragraph:

[0037] The tube providing a connection with a rack, more particularly with an engine block, can be supported directly in a bearing region of the engine block or, in one embodiment, it can be rotatably supported in a sleeve which can then be directly clamped into or bolted to the rack. The sleeve should be screwed into or bolted to the rack in the vicinity of the central plane of movement of the tensioning rollers. The tensioning arm connected in a rotationally ~~fast~~ fixed way to the one end of the tube can be embraced in a yoke-like way by the tensioning arm connected to the bundle of torsion springs. At least one of the tensioning arms, but preferably both, can comprise two halves whose dividing plane corresponds approximately to the central plane of movement of the tensioning rollers and tensioning arms. Each of the two halves can form a bearing region for the journal of one of the tensioning rollers.

Please replace paragraph [0040] with the following amended paragraph:

[0040] The bundle of torsion bars can be clamped in at the first end of the torsion bar assembly in a fixing bush, and it can be clamped in at the second end in a bush which is connected in a rotationally ~~fast~~ fixed way to one end of a tensioning arm. The bundle of torsion bars can be enclosed by a tube which, at its ends, is connected in a rotationally ~~fast~~ fixed way to the two ends of the bundle of torsion bars and forms a rotary tube spring connected functionally in parallel relative to the bundle of torsion bars. The tensioning device according to the fifth solution is used, more particularly, in a belt drive with at least two belt pulleys and a continuous belt, wherein the torsion spring assemblies are rotatably supported in a rack and are coupled so as to be rotatable in the same direction or in opposite directions. The longitudinal axes A_2 , A_4 of the torsion spring assemblies are positioned in an approximately mirror-symmetrical way relative to the angle bisecting plane of an angle which is formed by two tangents to three belt pulleys successively embraced by the belt. At least one of the tensioning arms can be supported by a friction unit or damping unit relative to the rack. In addition to the resilient method of coupling the tensioning arms relative to one another, at least one of the tensioning arms can additionally be spring-suspended relative to the rack by a further spring unit.

Please replace paragraph [0063] with the following amended paragraph:

[0063] Referring now to the drawings wherein like reference numerals are used to identify similar components in the various views, Figure 1 illustrates the principle of a belt drive used for an internal combustion engine in an axial view of the crankshaft. A continuous belt 11, such as a multi-groove V-belt or a toothed belt, moves across three inner belt pulleys: a belt pulley 12 which is fitted on the crankshaft and driven by same, and which drives the belt drive; a belt pulley 13, driven by the belt, for a compressor of an air conditioning system; and a belt pulley 14, driven by the belt 11, for an electric generator. The toothed belt rotates clockwise. Between the belt pulley 12 and the belt pulley 14, there extends a slack strand which is loaded by a tensioning roller 15 which is illustrated in different positions with different belt lengths. The tensioning roller 15 is arranged at a tensioning arm 19 so as to be pivotable around an axis of rotation A_2 which, at the same time, forms the central axis of a torsion spring assembly 20. The torsion spring assembly 20, at a first end, is secured in a rotationally ~~fast~~ fixed way to the engine block and, at its other end, carries the tensioning arm 19 with the tensioning roller 15 which is arranged radially relative to the central axis of the torsion spring assembly 20. The tensioning roller 15 is rotatable around an axis of rotation A_1 and is in contact with the smooth outer face of the belt. The tensioning arm 19 can be supported by a variable-length steering arm 16 on a rack. The steering arm 16 can comprise damping and/or spring elements. Of the various positions of the tensioning roller 15, the central position PN indicates the nominal position, whereas the adjoining positions PM2 and PE3 constitute tolerance regions, with the outer positions PM3 indicating the new condition prior to an initial rotation and position PE4 indicating an end stop beyond a permissible belt elongation and belt aging.

Please replace paragraph [0064] with the following amended paragraph:

[0064] Figure 2 shows the inventive belt tensioning device with its main parts with the cylindrical tensioning roller 15 positioned on the smooth outer face of the belt, a tensioning arm 19 and torsion spring assembly 20. The tensioning roller 15 is a lightweight plastic part which is rotatably supported on a bearing journal 21 at the tensioning arm 19. The tensioning arm 19 is a cranked carrier and comprises weight-reducing pockets 22 on one side. The tensioning arm 19 is held in a rotationally ~~fast~~ fixed way at the upper end of the torsion spring assembly, at its lower end, the torsion spring assembly 20 is secured by means (not shown in detail) in a rotationally ~~fast~~ fixed way to the engine block.

Please replace paragraph [0066] with the following amended paragraph:

[0066] Figure 4 shows the complete assembly according to Figure 3B in a larger scale. It can be seen that the pockets 22 provided for weight-reduction are provided on one side of the tensioning arm 19. One or more of the pockets 22 could also be formed as through apertures. At the free end of the tensioning arm 19, there is shown the bearing journal 21 on which the tensioning roller 15 is rotatably supported by means of a roller bearing 23. The inner bearing race of the bearing is held by a screw 24 on the bearing journal 21. The tensioning roller 15 embraces the outer bearing race of the bearing in a form-fitting and positive way. The tensioning roller is thus rotatable around an axis of rotation A_1 . At the other end of the tensioning arm 19, there is provided an eye 25 into which there is inserted a first bush 26 in a rotationally fast fixed way, such as by a press fit. Into the first bush 26, there is inserted one end of a bundle 27 of torsion springs 32, which spring bundle 27, in its entirety, is connected to the first bush 26 in a rotationally fast fixed way. The other end of the bundle 27 of torsion springs 32 is inserted into a second bush 28, which bundle 27, again, in its entirety, is connected to the second bush 28 in a rotationally fast fixed way. The above-described end of the tube 29 extends over the lower end of the first bush 26, with sleeves 30, 31 serving different functions being inserted between the tube 29 and the first bush 26. In the fitted condition, the lower end of the torsion spring assembly 20 is clamped into a holding mechanism in a rotationally fast fixed way, either directly via the second bush 28 or via the outer circumference of the tube 29. Together, the spring bundle 27 and tube 29 can form a torsion spring unit as part of the torsion spring assembly 20. The tensioning arm 19 is thus resiliently rotatable relative to the second bush 28 around the axis A_2 . If suitably dimensioned, the sleeves 30, 31 can serve as bearing sleeves or friction damping sleeves if the upper end of the tube 29 is rotatable relative to the first bush 26. The sleeves 30, 31 can also be used as rotary stop sleeves for the upper end of the tube 29, if the tube 29 is to serve as a tube spring which is sequentially connectable to the torsion spring bundle 27 and which, from a certain angle of rotation of the torsion spring assembly onwards, is to increase the spring rate. The sleeves 30, 31 can also serve as clamping sleeves which produce a rotationally fast connection between the upper end of the tube 29 and the first bush 26, so that the tube is connected functionally in parallel to the torsion spring bundle 27, increasing the spring rate over the entire angle of rotation of the torsion spring assembly. As the spring bundle 27, when under torsion, is slightly shortened, the ends of the spring bundle can be held in a rotationally fast fixed way in at least one of the first and second bushes 26, 28 or in both, but they can be slightly axially displaceable.

Please replace paragraph [0070] with the following amended paragraph:

[0070] Figure 6 shows the inventive belt tensioning device with its major components with the first tensioning roller 15, the first tensioning arm 19', the second tensioning roller 35, the second tensioning arm 39 and a torsion spring assembly 20. The rollers are advantageously made of lightweight plastic parts which are rotatably supported at the ends of their tensioning arms 19', 39. The first tensioning arm 19' is a straight carrier which is held in a rotationally fast fixed way at the upper end of the torsion spring assembly. The second tensioning arm 39 is a cranked beam which is held below the first one on the torsion spring assembly 20' in such a way that the tensioning rollers 15, 39 run in one plane. The torsion spring assembly 20' is preferably supported in such a way that it is freely rotatable in the engine block.

Please replace paragraph [0072] with the following amended paragraph:

[0072] Figure 8 shows the complete assembly according to Figure 7B in a larger scale. The first tensioning arm 19' with the first tensioning roller 15 is shown in section in the region of the torsion spring assembly 20' only, whereas the second tensioning arm 39 with the second tensioning roller 35 is shown in section in the center. It can be seen that the pockets 42 provided for weight-reducing purposes are provided on one side of the first tensioning arm 19 although, again, they could be through-apertures. At the free end of the second tensioning arm 39, there is shown the bearing journal 41 on which the second tensioning roller 35 is rotatably supported by means of a roller bearing 43. The inner bearing race of the bearing 43 is held by a screw 44 on the bearing journal 41. The second tensioning roller 35 embraces the outer bearing race of the bearing 43 in a form-fitting and positive way. The second tensioning roller 35 is thus rotatable around an axis of rotation A_2 . At the sectioned end of the first tensioning arm 19', there is provided an eye 25 into which there is inserted a first bush 26 in a rotationally fast fixed way. Into the first bush 26, there is inserted one end of a bundle 27 of torsion springs 32, which spring bundle 27, in its entirety, is connected to the first bush 26 in a rotationally fast fixed way. The other end of the bundles 27 of torsion springs 32 is inserted into a second bush 28, which bundles 27, again, in its entirety, is connected to said second bush 28 in a rotationally fast fixed way. A tube 29 connected to the second bush 28 in a rotationally fast fixed way is placed onto the first and second bushes 26, 28. The above-described end of the tube 29 extends over the lower end of the first bush 26, with sleeves 30, 31 being inserted between the tube 29 and the first bush 26. If dimensioned accordingly, the sleeves 30, 31 can serve as bearing sleeves or friction damping sleeves. The second tensioning arm 39 is placed in a rotationally fast fixed way onto the upper end of the tube 29. The second tensioning arm 39 is supported axially downwardly via a spacing sleeve 40 which is positioned on a flange 38. Between the tube 29 and the spacing sleeves 40, there are positioned centering sleeves 36, 37. The second tensioning arm 39 is supported upwardly via plate springs 33 and friction discs 34 on the first tensioning arm 19', which plastic springs 33 and friction discs 34, together, form a friction damping unit. In this way, the bundle 27 of

torsion springs 32 and the tube 29 form spring units which are connected functionally in series and which can be incorporated under a respective pretension relative to the belt. If, alternatively, the second bush 28 and the lower end of the tube 29 are firmly clamped into holding mechanism, the first tensioning arm 19' with the first tensioning roller 15 is supported via the bundle 27 on the holding mechanism and, independently thereof, the second tensioning arm 39 with the second tensioning roller 35 is supported via the tube spring 29 on the holding mechanism. As the spring bundle 27, when under torsion, is slightly shortened, the ends of the spring bundle 27 can be held in a rotationally fast fixed way in at least one of the first and second bushes 26, 28 or in both, but they can be slightly axially displaceable.

Please replace paragraph [0082] with the following amended paragraph:

[0082] Figure 15 shows in greater detail the design of the assembled tensioning arm 19 comprising the two arm halves 48, 49. A bearing journal 21 is inserted into the bearing aperture prior to the two halves 48, 49 being assembled. The tensioning roller 15 is rotatably supported in the tensioning arm 19 by way of a roller bearing 23 not shown in detail. At the opposite end, the sleeve 50, at its end face, is connected in a rotationally fast fixed way to a first bush 26 which is rotatably inserted into a tube 29 and forms a bearing 54 therewith. A torsion spring assembly 32, by means of its upper end, is inserted in a rotationally fast fixed way into the first bush 26. The lower end of the torsion spring 32 is inserted in a rotationally fast fixed way into a second bush 28. The tube 29 is axially connected in a rotationally fast fixed way to the second bush 28. Between the sleeve 50 and the upper end of the tube 29 there is shown a multi-component sleeve which can form a friction damping element 55 between the eye 25 and the upper end of the tube 29. In accordance with the invention, the central plane of the movement E of the tensioning roller 15 and of the tensioning arm 19, which, at the same time, forms the diving plane between the halves 48 and 49, is positioned within the axial region A of the bearing 54. More particularly, the plane E is positioned approximately centrally relative to the axial length A of the bearing 54. The bearing 54 between the tensioning arm 19 and the tube 29 is thus free from transverse forces and bending moments, so that optimum functioning of the bearing is ensured.

Please replace paragraph [0083] with the following amended paragraph:

[0083] Figure 16 shows an inventive belt tensioning device in a further embodiment with a first tensioning roller 15, a first tensioning arm 19', a second tensioning roller 35, a second tensioning arm 39', and a torsion spring assembly 20'. The first tensioning arm 19', which is connected in a rotationally fast fixed way to a bush 26 shaped cover-like, at its tope end, is divided yoke-like, whereas the second tensioning arm 39' which his connected to the tube 29 of the torsions spring assembly

20' engages between the two yoke parts. It can be seen that a torsion spring 32 form-fittingly engages the bush 26. The two tensioning arms 19' and 39' are each composed of two halves, as shown in greater detail at the top end of Figure 14.

Please replace paragraph [0084] with the following amended paragraph:

[0084] Figure 17 shows the device according to Figure 16 in a partial section through the central axis A_2 of the torsion spring 32. The torsion spring 32, at its top end, is form-fittingly inserted into the first bush 26 which, via its cover-like shape, is connected to the first tensioning arm 10' in a rotationally ~~fast~~ fixed way and which, at its lower end, is connected to a second bush 28 in a rotationally ~~fast~~ fixed way. The second bush 28, in turn, is connected to the tube 29 in a rotationally ~~fast~~ fixed way. The second tensioning arm 39' which, as can be seen, also consist of two halves, is firmly placed onto the upper end of the tube 29. In this embodiment, too, the first bush 26 and the tube 29 form a bearing region 54 with one another. Inside the eye 25 of the tensioning arm 19' there is positioned a further sleeve 55 which forms a friction damping element which is effective between the upper end of the tube 29 and the eye 25. In the present case, the tube 29 is surrounded by a spacing sleeve 40 relative to which the tube 29 is freely rotatable. The spacing sleeve 40 serves to secure the rotary spring assembly 20' in the rack. The central plane of movement E of the tensioning rollers and tensioning arms (not illustrated in this Figure), which, at the same time, forms the central dividing plane of the two tensioning arms 19' and 39', in this embodiment, too, in accordance with the invention is positioned centrally relative to the axial length A of the bearing 54 between the first bush 26 and the tube 29, so that the bearing assembly is free from transverse forces and bending moments and operates in an interference-free way, even if high forces are generated between the first and second tensioning arms 19', 39'.